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ACCOMPLISHMENTS
OF
SCIENTIFIC RESEARCH
IN THE MINISTRY OF THE ENVIRONMENT
ONTARIO

1983 - 84

EXTERNAL GRANTS & CONTRACTS

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Ministry of the Environment

The Honourable
Andrew S. Brandt
Minister

Dr. Allan E. Dyer
Deputy Minister

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1.0 Introduction

The last decade was marked by increasing public and government concern over the quality of our environment and the impact of various environmental contaminants on human health. Many of the traditional tools for pollution control require continuous upgrading to handle these complex environmental problems. Enforcement agencies require increasingly complex scientific information on which to base their decisions.

In Ontario, scientific research is making a growing contribution to meeting these needs. A detailed research plan developed by the Ministry of the Environment identifies research needs and priorities and allows for effective channelling of funds to scientists in universities and consultants for research on important environmental proble The research program provides a sound scientific basis for policy and decision-making on environmental issues.

The present report highlights the accomplishments of research projects completed to date. More detail on the completed projects can be obtained from the 1982-83 Report on Accomplishments. Information on ongoing and new research initiatives is provided in the Appendix.

2.0 Financial Information

Since 1977, the Government of Ontario has distributed a portion of the proceeds from the Provincial Lottery to various Ministries for the funding of research. The Ministry of the Environment has used its share to initiate

a comprehensive program of health-oriented environmental research and to undertake clean-up projects to remove health hazards caused by environmental contaminants. The funding provided through the Lottery program is additional to monies from MOE's regular scientific research budget. Financial resources for external research for the 1984-85 fiscal year include $2.3 million from the Provincial Lottery and $0.8 million from the Ministry's regular budget for a total of $3.1 million compared to $2.3 million in 1983-84.

3.0 Technology Transfer

The MOE research program places great emphasis on technology transfer and utilization of research results. Annual conferences sponsored by MOE have provided researchers with an opportunity to present their results to large and varied audiences comprised of university, industry and government personnel, private consultants and environmental groups. Conference proceedings are published annually and widely distributed to research organizations and other agencies.

4.0 Accomplishments of Completed Research Projects

The Ministry of Environment's broad mandate "to protect the quality of our environment, including air, water and land" requires new scientific information from many different disciplines. A selection of important scientific information generated through the Ministry's research program is summarized in the following sections:

4.1 Clean-up of Contaminants and Spills

- Lead contaminated soil in the vicinity of lead smelting plants was removed (jointly with Toronto Lead Smelters).

- All abandoned and inactive mine tailing sites in Ontario were identified and assessed for their chemical stability and potential for environmental degradation.

- Houses in Elliot Lake were checked for radiation contamination and remedial measures were implemented as required (jointly with Federal government).

4.2 Treatment of Drinking Water

- A preliminary study evaluated the feasibility of using activated carbon as an "in plant" modification for organic contaminant removal.

- The use of ozone as an alternative to chlorination for drinking water was investigated. A pilot scale ozonation system is now under consideration for testing.

4.3 Treatment of Wastewater and Sludge

- Artificial marshes were evaluated as a new and inexpensive alternative to conventional wastewater treatment technologies. Criteria for the design and operation of full scale facilities are being developed.

- The effects of sludge on agricultural lands were investigated and led to the development of new sludge disposal guidelines.

- The environmental conditions which influence the die-off of pathogenic bacteria in chlorinated and unchlorinated sewage effluents and in receiving waters were evaluated.

- Ultra-violet disinfection was tested as an alternative to chlorination of sewage effluents. The practical implications of large scale use of this technology are under review.

4.4 Landfill Construction and Operation

- A study on attentuation of metals in landfill leachates has generated information on migration of leachates, and contaminant maps and has importance for future landfill construction and operation.

- A study on methane gas migration at closed landfill sites, has provided useful information for determining waste site management practices and land use criteria.

4.5 Air Quality

- An extensive epidemiological study of the effects of SO_2 and particulates on the lung functions of children in Hamilton schools and homes has been completed. The preliminary report shows the relative importance of indoor air as a source of pollution.

- The significance of road dust as a source of suspended particulates and the need for dust control strategies has been evaluated. The implications are being reviewed, especially for highly industrialized areas in Ontario.

- The effects of indoor and outdoor air on the health of asthmatic and non-asthmatic individuals have been investigated using specially developed portable monitors. Further work is required to expand the findings and examine exposure to other hazardous contaminants.

4.6 Water Quality

- A preliminary study on the relationship between micro-organisms and the incidence of bather illness at beaches, has led to a larger study being carried out for the Ministry. The results will be useful for beach management.

- A major watershed study has outlined a cost effective stormwater management strategy which will improve water quality in the Rideau River and permit a wider range of recreational uses. (Jointly with Federal and Municipal governments).

4.7 Effects of Hazardous Contaminants

- A literature review of the carcinogenic and mutagenic effects of some organic contaminants has provided an information base for the setting of environmental standards.

- Industrial substitutes for PCB's were tested for bioaccumulation, acute and chronic toxicity to fish and found to have minimal effects.

- Lead and cadmium concentrations in human vital organs were examined to provide baseline data for future evaluations of abnormal levels.

4.8 Analytical Procedures

- Improved methods were developed for the detection of virus in environmental samples.

- Improved biological testing methods were developed for the identification of carcinogenic chemicals.

- Improved analytical procedures were developed for the identification and quantification of contaminants.

4.9 Environmental Management

- A program aimed at reducing pesticide usage in Agriculture (Integrated Pest Management) has undertaken a large scale trial of the use of sterilized breeding females to control onion maggot damage without extensive pesticide use.

5. APPENDIX

SUMMARY OF NEW AND ONGOING

1983-84 RESEARCH PROJECTS

CLEAN-UP OF CONTAMINANTS AND SPILLS

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
104 PL	"Assessing the Impact of Hazardous Liquids Spilled onto Soil"	University of Waterloo	$141,750 1983-87	- To develop methods for predicting the dispersal, attenuation and environmental fate of hazardous liquids spilled onto soil. This information is required for handling emergency spills.
111 RR	"Ottawa River Nuclear Spill Contingency Model Development"	Gore & Storrie	$ 19,380 1983-84	- To develop a two-dimensional pollutant dispersion model for assessing the impact of accidental discharges on waterbodies. The results will be used to predict the arrival time and concentration of spilled hazardous chemicals.

DRINKING WATER TREATMENT

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
62 PL	"Investigations of Nitrate Distributions and Nitrogen Transformations in a Shallow Sandy Aquifer near Alliston, Ontario"	University of Waterloo	$141,100 1982-85	- To study nitrate contamination of domestic well water and develop a groundwater nitrate removal procedure. The findings will be used to reduce or eliminate the problem of nitrate contamination of domestic well water in agricultural areas of Ontario.
99 PL	"Trace Organic Contaminant Removal from Drinking Water"	MacLaren Plansearch	$900,000 1983-86	- To assess the effectiveness of organic contaminant removal with existing water treatment plant processes and with an activated carbon add on.

WASTEWATER TREATMENT

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
18 PL	"Development of an Experimental Marsh Treatment Facility at Listowel, Ontario"	Municipality	63,000 1983-85	- Continued monitoring and operation of the Listowel marsh treatment system, previously constructed under this project.
65 RR	"Hazardous Contaminants in Hamilton WPCP"	Canviro Consultants Ltd.	$ 55,600 1982-84	- To estimate annual loadings of hazardous contaminants in WPCP discharges into Hamilton Harbour and to assess contaminant removal efficiency.
105 PL	"Evaluation of Beak Data on the Effects of Hydraulic Characteristics and Effluent Chlorination at WPCPS on the Incidence of Micro-organisms of Public Health Significance in Receiving Waters"	contract to be let	1983-85	- Data previously generated requires statistical evaluation prior to its use in setting a standard for treated sewage effluent disinfection for control of micro-organisms.

LANDFILL CONSTRUCTION AND OPERATION

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
58 PL	"Field Measurements of Infiltration Through Landfill Covers"	Gartner Lee Ltd.	$ 38,700 1982-84	- To study infiltration of water through various types of cover materials used in the construction of landfill sites. The anticipated results will assist MOE in preventing the leakage of hazardous contaminants to groundwater.
63 PL	"Design of Groundwater Monitoring Programs for Waste Landfill Sites"	University of Toronto	$ 30,000 1982-85	- To apply statistical methods and models to monitoring groundwater quality at various landfill sites. The results will be used for improvements to the measurement of groundwater quality.

AIR QUALITY

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
40 PL	"Effects of Ambient Air Pollution (Assessed by Personal Indoor and Outdoor Monitoring) on Humans"	Gage Institute, University of Toronto	$161,000 1979-84	- To assess health effects of air pollution on non-asthmatic and asthmatic individuals using personal monitors to measure several air contaminants.
47 PL	"Investigation of Sleep Disturbance Effects of Road Traffic Noise"	Wilson & Associates	$153,000 1980-84	- To determine the relationship between road traffic noise and sleep disturbance and their effects on public health. The anticipated results will assist in reviewing noise criteria.
56 PL	"Controlling Sulphur Dioxide Emissions. What are the Costs?	University of Toronto	$ 30,000 1981- 84	- To examine the economics of SO_2 emission control in Sarnia or Nanticoke industrial complexes. Comparison between alternative pollution control enforcement policies will focus on cost effective methods for SO_2 reduction.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
70 RR	"Production of Ozone Insensitive Field Bean Varieties"	University of Guelph	$54,800 1980-84	- Ozone tolerance of beans will be investigated in an attempt to produce ozone insensitive varieties.
71 RR	"Development of a Strategy for Predicting the Impact of Odorous Pollutants from Fast Food Restaurants on the Surrounding Community"	University of Windsor	$27,400 1981-84	- Ambient and source sampling will be evaluated, including laboratory simulation.
72 RR	"Assessment of Impact of Oxidant Injury on Potato and on the Development of Early Blight"	University of Guelph	$82,100 1980-85	- Ozone injury to potato and the use of chemical protectants will be assessed. Study results will be used to predict potential crop losses.
73 RR	"Sweet Corn and Green Bean Response to Air Pollution in Southern Ontario"	University of Guelph	$51,600 1982-85	- To determine the efficiency of chemical protectants against ozone damage on sweet corn and green beans.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
88 RR	"Study of Inhalable Particulate at Regional Sites"	Air Resources Branch	$142,250 1982-84	- To test the perfonmance of dichotomous samplers, and to determine the correlation between total and suspended particulate matter in air at 8 industrial locations in Ontario.
93 PL	"Diagnostic Testing of the SWARU Installation in Hamilton"	ORF & Envirocon Contracts	$457,300 1983-84	- To conduct sampling and analyses of SWARU emissions and fly ash and to optimize SWARU operating conditions to minimize formation of hazardous compounds.
100 RR	"Dispersal of Airborne Particulates on a Short and Long-Term Scale"	Queen's University	$41,000 1981-84	- Heavy metals in air samples will be measured using proton induced x-ray emission. The results will be correlated with those obtained on tree rings and will be used to establish short and long-term dispersal of industrial emissions.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
101 RR	"Retrospective Correlation Spectroscopy and its Application to Atmospheric Monitoring"	York University	$43,500 1983-86	- To develop retrospective correlation spectroscopy techniques for observational atmospheric spectral data handling. Computer software will be developed and applied to field atmospheric data.
107 RR	"Gas Phase Photochemistry of Polychlorinated Biphenyls"	University of Guelph	$22,500 1983-85	- To study the photochemistry and reaction mechanisms of PCB in air and nitrogen. The results will provide a better understanding of the photodecomposition and long range transfer of PCB in air.
115 PL	"Survey of Blood Lead Levels in School Children"	Contract	Phase 1 $34,000 1983-84 Phase 2 1984-85	Phase 1. - Included purchase of sampling equipment only. Phase 2. - To determine lead blood levels in school children from Ontario communities with known above average ambient air lead concentrations.

WATER QUALITY

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
49 PL	"Aquatic Toxicity Studies of Multiple Organic Compounds"	Lakehead University	$170,200 1981-84	- To determine the toxicity of selected hazardous contaminants and industrial organics to fish.
89 PL	"Epidemiological Studies of Disease Incidence and Recreational Water Quality at Selected Areas in Southern Ontario"	University of Toronto	$149,000 1983-85	- To correlate bather illness with the presence of microorganisms in recreational waters. This information will be of value in managing recreational waters.
94 RR	"Water Quality Analysis of Trout Farm Effluent"	University of Guelph	$16,400 1983-84	- To determine the water quality of trout farm effluents and to correlate the results with operating practices. The results will provide a technical basis for MOE criteria on aquaculture effluents.

HAZARDOUS CONTAMINANTS

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
74 RR	"Evaluation of Contaminated Water and Soil Sites as Sources of Airborne Hazardous Materials"	University of Toronto	$51,000 1982-85	- To determine the rate of volatilization of organic pollutants from water and soils.
90 RR	"Suppression of Immune Defences by Halogenated Aromatic Compounds"	McMaster University	$233,000 1979-84	- To examine the effect of PCBs and PBBs on immune systems and related disease. This information will be valuable for understanding the effects of exposure to hazardous chemicals in mammalian species.
84 RR	"Collaborative Study on Short-Term Tests for Genotoxicity and Carcinogenicity"	York University and MOE	$88,000 1982-84	- To participate in a U.N. international study on genotoxicity and carcinogenicity of a group of hazardous chemicals. The results will evaluate their properties and the methods used in the testing.
91 RR	"Chemical Identification and Biological Assay Studies of Environmental Mutagens, Promoters and Inhibitors"	York University	$402,800 1981-85	- To determine mutagenic and carcinogenic activities of hazardous contaminants using newly developed methods and to determine biohazards of individual and mixtures of contaminants.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
95 PL	"Toronto Junction Triangle Health Study"	Funded by the City of Toronto, Ministry of Health and MOE. Contractor McGill University	$25,000 1983-84	- To evaluate health effects of industrial pollution in Junction Triangle. Abnormalities in still-births or death rates of Junction Triangle residents will be compared to statistics from other areas of Toronto.
66 RR	"Monitoring Genotoxicity in the Atmosphere using Sister Chromatid Exchange in Mice"	University of Windsor	$61,400 1982-84	- To develop a procedure to monitor the atmosphere for agents genotoxic to a mammalian system. The study will complement MOE activity in genotoxicity, by providing a measuring technique to examine real-life air pollutant mixtures, using mice as representatives for the mammalian system.
69 RR	"A Mass-Spectrometric Study of selected Air Pollutants"	Trent University	$43,600 1982-84	- To investigate the reaction mechanism and specific rates of 9 PAH's including oxidation reactions. The reactions of PAH's in air are not fully understood. The information, together with MOE efforts to improve PAH sampling, would assist in producing a reliable data base for setting guidelines.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
106 RR	"Determination of Volatilization Rates of Organic Chemicals of Public Health Concern"	Gore & Storrie Ltd.	$24,100 1983-84	- To determine volatilization rates of organic compounds of public health concern in provincial streams and rivers and correlate these with bulk flow characteristics. The results will be useful in assessing the transport and fate of organic chemicals entering provincial waterways.
68 RR	"Experimental and Environmental Modelling Studies of Hazardous Substances in Ontario"	University of Toronto	$165,000 1982-85	- To study the environmental fate of specific toxic substances and devise novel hazard assessment methods. The model will be extended to include human exposure.
87 RR	"A Biological Model for Partitioning of Mercury, Lead, and Cadmium in Aquatic Systems"	University of Toronto	$13,000 1982-84	- To investigate the fate of toxic metals and their bioaccumulation, using algae and a "unit world" microcosm.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
108 RR	"Contaminant Mobilization and Uptake from Mine Tailings at Cobalt, Ontario"	Hanna Associates Ltd.	$49,435 1983-85	- To determine the mobility and bioavailability of contaminants, primarily heavy metals, in mine tailings under varying moisture and chemical regimes. The characteristics of a marsh system built on tailings and flooded with sewage effluent will be defined in relation to mobilization rates of heavy metals under natural conditions. This information has important implications for the future use of tailing basins for marsh wastewater treatment systems.
109 RR	"Effects of Metals from Mine Tailings on the Microflora of a Marsh Treatment System"	University of Toronto	$49,000 1983-85	- To assess the effects of elevated levels of metals on the normal microflora of a marsh treatment system.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
114 PL	"Effects on the Muscle of Young Fish and Rats of Exposure to Lead, Cadmium and Mercury"	York University	$16,310 1983-84	- To study enzymatic and genetic effects of lead, cadmium and mercury on fish and young rats.
117 RR	"To Investigate the Short-Term Mutagenicity Test and Chemical Composition of Benzene Extractable Fractions of Coke Oven Emissions"	Ontario Research Foundtion	$205,000 1983-86	- To study coke oven emissions, through mutagenicity testing, and chemical analysis of air particulates and look for correlation between short-term mutagenicity results and human health effects. This information is required for establishing environmental standards.
118 PL	"Occurrence and Mobility of Hazardous Organic Chemicals at Ontario Landfills"	University of Waterloo	$331,000 1983-87	- To study and determine the nature, concentration and mobility of hazardous organic compounds that may occur in groundwater at representative municipal landfills in Ontario.

ANALYTICAL PROCEDURES

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
61 PL	"Development of a Methodology for the Concentration and Detection of Rotavirus and Hepatitis A Virus in Environmental Samples"	University of Toronto	$49,000 1982-84	- To develop sensitive methods for the detection of virus in sewage effluents and surface waters
64 PL	"The Development of a Freshwater Fish Test to Identify Aquatic Toxic Contaminants"	University of Guelph	$37,500 1982-85	- To develop genotoxicity testing methods using fish as the test animal.
79 RR	"Development of a Tunable Diode Laser-Based Hydrogen Peroxide Monitor"	York University	$58,500 1982-85	- To Develop a spectrometer to measure hydrogen peroxide concentrations in air, and conduct a feasibility study for measuring ammonia and formaldhyde in air.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
81 RR	"Synthesis of Polynuclear Aromatic Hydrocarbons of Interest in Environmental Pollution"	York University	$13,500 1982-84	- To prepare specific PAHs. Samples will be used as laboratory standards.
80 RR	"Chemical Speciation of Particulate Matter"	McMaster University	$49,230 1980-84	- To develop procedures for chemical identification of airborne particulate matter using Neutron Activation Analysis.
82 RR	"Laser Induced Emission Spectroscopy of Polycyclic Hydrocarbons in Low Temperature Matrices"	York University	$53,800 1982-85	- To develop a laboratory capability for fluorescence spectra of PAHs.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
78 RR	"Methods for the Sampling and Analysis of Nitro-substituted Polycyclic Aromatic Hydrocarbons"	McMaster University	$101,000 1979-84	- To synthesize nitro-PAHs and develop analytical methods. These methods will be used to examine auto exhaust and urban air for the presence of PAHs.
75 RR	"Provision of PAHs and Aza-PAHs as Environmental Analytical Standards"	University of Waterloo	$69,900 1981-84	- To synthesize PAHs and Aza-PAHs for use as analytical standards.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
77 RR	"Multi-element Determination of Metals and Metal Compounds in Air and Related Samples"	University of Toronto	$ 94,500 1979-84	- To develop analytical techniques for different chemical states of metals using GC-AFS.
83 RR	"Methods for the Sampling and Analysis of Asbestos Air Pollution in Ontario"	McMaster University	$102,000 1981-84	- To obtain data on asbestos in outdoor air using Electron Microscopy and Optical Microscopy.
85 RR	"Evaluation of Pulsed Nuclear Magnetic Resonance Technique in the Analysis of Environmental Samples"	Ryerson Polytechnical Institute	$49,000 1982-84	- A new NMR instrument will be used to develop methods for the characterization of organic compounds in wastes.
67 RR	"To Devise and Implement a Revised Monitoring Scheme for Persistent Toxic Chemicals in Great Lakes Sports Fish"	Zenon Environmental Inc.	$130,000 1982-85	- To develop and implement new monitoring methods for the characterization of persistent chemicals in Great Lakes fish.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
96 PL	"Development of a Non-GC/MS-Oriented Protocol for Routine Analysis of Organic Trace Contaminants in Municipal WPCP Raw Sewage and Final Effluents"	MANN Testing	$180,000 1983-85	- To develop a laboratory protocol for the characterization of organic contaminants in sewage and treated effluents.
98 RR	"Organic Contaminants in the Atmosphere, Effects of Absorption Tube Storage and Sample Handling Techniques on Measured Values"	ORF	$40,800 1983-85	- To determine the optimum storage and handling conditions for organic air sampling tubes, and assess the effect of storage and handling on hazardous contaminants.
112 RR	"Comparison of the Ames Test and the Replicative Killing Assay as Detectors of Mutagenicity in Chemical Compounds and Environmental Samples"	York University	$13,000 1983-84	- To evaluate the replicative killing assay as an adjunct to the Ames test for mutagenic activity and to compare its specificity and sensitivity on mutagenic standards and concentrated water samples.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
113 PL	"Differentiation of Fecal Coliforms and Fecal Streptococci and Verification of Newer Tests to Determine Human and Non-Human Feces"	University of Toronto	$23,200 1983-84	- To develop microbiological methods for specific identification of sources of fecal pollution. The new methods will be validated and interrelated to present methods.
102 PL	"Studies of Methodology and Instrumental Capabilities for Optimum and Rapid Analysis of PCDD and PCDF Compounds in Water"	University of Waterloo	$42,800 1983-85	- To develop sensitive methods for trace determination of dioxins and furans in drinking and surface waters and incinerator ash and verify these methods.

Project Reference Number	Title	Organization	Cost & Duration	Purpose & Benefits
103 PL	"An Extraction and Concentration Method for the Testing of Landfill Leachates, Soil Fractions and Liquid Industrial Wastes for Genotoxic Organic Compounds"	ORF	$300,000 1983-86	- To develop and validate methods for mutagenicity testing of leachates and groundwater.
110 RR	"Modifications to Chemi-Luminescent Instruments measuring NO and NO_2 from an Aircraft and Mobile Laboratories".	York University	$22,200 1983-84	- To modify existing nitrogen oxide detectors for use to measure NO and NO_2 in tropospheric air from aircraft and mobile laboratories. The instrument will be used by MOE for testing urban plumes and transport models at high sensitivity.